USING SCIENTIFIC CALCULATORS

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Students in trigonometry classes often own very sophisticated calculators but have limited working knowledge of them. The following exercise is designed to increase awareness of the function buttons on a calculator, review the order of operations from algebra and familiarize students with the decimal values of certain irrational numbers.

The examples given emphasize the use of trigonometric functions but the concept can be expanded easily to include logarithms, exponentials, hyperbolic functions, factorials, and whatever else may appear on a student's calculator.

Object of the Exercise: To have the given number appear on the display of a scientific calculator without pressing any number keys.

Procedure:

1) Note when a calculator is turned on, a "0" is displayed.
2) Note that the calculator has various modes of operation such as degrees, radians, etc.
3) Create a mathematical expression (using "0" as the original argument of a trigonometric function) which has a value equivalent to the desired number.
4) Decide the order of keystrokes needed to evaluate the expression.

For those students who possess a calculator which shows a blinking cursor rather than a zero, the rules may be changed to allow the use of the number key "0" as needed for the entered expression to be valid. Teachers should realize that these students will have an advantage when writing the expression which was evaluated.

Examples:

Number Displayed	Possible Solution
90	DEG, COS^{-1}
1	DEG, COS^{-1}, SIN

2	DEG, COS^{-1}, SIN, +, COS^{-1}, COS, =
.5	DEG, COS^{-1}, SIN, +, COS^{-1}, COS, =, $\frac{1}{x}$
−1	DEG, COS^{-1}, SIN, +/−
30	DEG, COS^{-1}, SIN, +, COS^{-1}, COS, =, $\frac{1}{x}$, SIN^{-1}
45	DEG, COS^{-1}, SIN, TAN^{-1}
$\frac{\pi}{2} \doteq 1.570796237$	RAD, COS^{-1}
$\frac{\pi}{4} \doteq .785398163$	RAD, COS^{-1}, SIN, TAN^{-1}
$\frac{\sqrt{3}}{3} \doteq .577350269$	DEG, COS^{-1}, SIN, +, COS^{-1}, COS, =, $\frac{1}{x}$, SIN^{-1}, TAN
$\sqrt{3} \doteq 1.732050808$	DEG, COS^{-1}, SIN, +, COS^{-1}, COS, =, $\frac{1}{x}$, SIN^{-1}, TAN, $\frac{1}{x}$
$\frac{\sqrt{2}}{2} \doteq .707106781$	DEG, COS^{-1}, SIN, TAN^{-1}, SIN
$\sqrt{2} \doteq 1.414213562$	DEG, COS^{-1}, SIN, TAN^{-1}, SIN, $\frac{1}{x}$

It is possible to get a variety of numbers to appear without using the number keys. It is clear that all rationals within the range of the calculator and the decimal approximations of quite a few irrationals and transcendentals can be obtained. Teachers may wish to ask their students, "Is there a specific class of numbers which cannot be obtained?"

Be certain to remind students to write the mathematical expression being evaluated.

$$e.g. \quad TAN^{-1}\,[\,SIN\,(\,COS^{-1}\,0^{\circ}\,)\,] \longrightarrow 45$$

Either you can provide all problems or let the students create and try to stump each other.
